Do Large Language Models Recognize and Utilize Non-Mandated Pragmatic Enrichments?

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Research questions

Large Language Models (LLMs) succeed in making mandated pragmatic inferences, such as presuppositions and implicatures [1] and show significant improvement from earlier models in their pragmatic abilities [2,3]. However, It is unclear whether these models can draw pragmatic inferences when sentence felicity is not at stake.

MAIN QUESTIONS

- Do LLMs have the ability to recognize non-mandated pragmatic inferences, in the case of conversational elicitures?
- Can LLMs utilize the potential for elicitures to influence downstream linguistic tasks, such as syntactic processing?

Background

Conversational Eliciture: a "non-mandated" pragmatic inference [4].

a) Melissa detests the children who are arrogant and rude.
⇝ children are detested by Melissa ***because*** they are arrogant and rude.
b) Melissa detests the children who live in La Jolla.
⇝ children are detested by Melissa ***and*** they live in La Jolla.

What triggers this inference?
Implicit causality verbs (e.g., **detests**) impute causality to the one of the participants associated with the eventuality the verb denotes, which creates a strong bias toward an explanation [5].

c) Melissa detests the children
Why does Melissa detest the children?
d) Melissa babysits the children.
e.g., What happened as a result?/What else does Melissa do?/…

Using elicitures in relative clause (RC) attachment
The default low-attachment bias of RC in English can be shifted toward high attachment [6,7].

e) Melissa babysits the children of the musician who ___
f) Melissa detests the children of the musician who ___

The reasoning is three-fold:
1. IC verbs create a strong expectation for an ensuing explanation.
2. The explanation can be provided by the immediately-following RC.
3. Object-biased IC verbs create a strong expectation that the explanation will be about the verb's direct object (*i.e., the children*).

References

[1] Hu et al. (2023). *Proceedings of ACL.* [2] Bayer et al. (2021). *Proceedings of NAACL.* [3] Davis & van Schijndel (2020). *Proceedings of CoNLL.* [4] Cohen & Kehler (2021) . *Philosophers' Imprint.* [5] Garvey & Caramazza (1974). *Linguistic Inquiry.* [6] Rohde, Levy, Kehler (2011). *Cognition.* [7] Hoek et al. (2021). *Cognition.*

Links

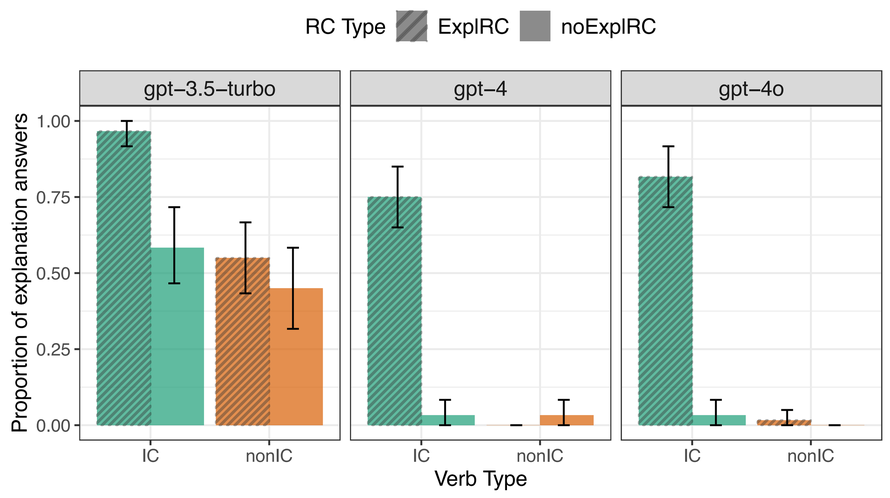
Data and analysis scripts can be accessed at: https://github.com/pennydy/llm_eliciture.

Experiment 1: Detecting elicitures

Stimuli (60 sentences in each condition)
Melissa detests/babysits the children who are arrogant and rude. [IC/nonIC, ExpIRC]
Melissa detests/babysits the children who live in La Jolla. [IC/nonIC, noExpIRC]

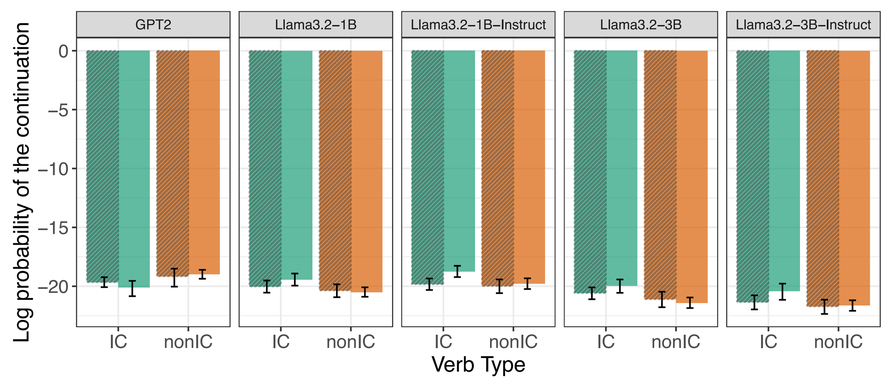
Closed-source models

GPT-3.5-turbo, GPT-4, and GPT-4o
Prompt
Sentence: Melissa detests the children who are arrogant and rude.
Question: Does this sentence explain why Melissa detests the children? If yes, please provide an explanation. If not, just say no and you don't need to provide an explanation.
Answer:



Open-source models

GPT-2, Llama-3.2-1B, Llama-3.2-3B, Llama-3.2-1B-Instruct, Llama-3.2-3B-Instruct
Prompt
Melissa detests the children who are arrogant and rude, and I don't know why.



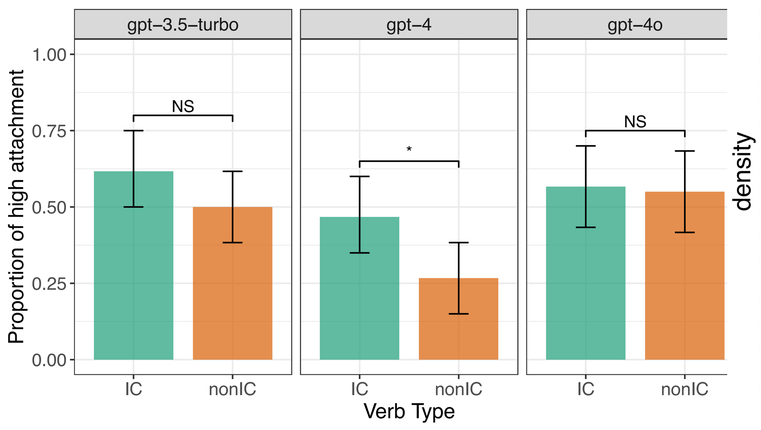
Results
All closed-sourced models provide more explanation responses in the IC/ExpIRC condition than in the other three conditions, suggesting that they have the ability to draw elicitures.
All Llama models show the effects of verb type and the content of the RC as well as their interaction on the log probability of the continuation, suggesting that they can draw eliciture inferences, regardless of the model size and the use of additional instruction-tuning. GPT-2 shows no such evidence.

Experiment 2: Using elicitures in syntactic processing

Stimuli (60 sentences in each condition)
Melissa detests/babysits the children of the musician who ___ [IC/nonIC]

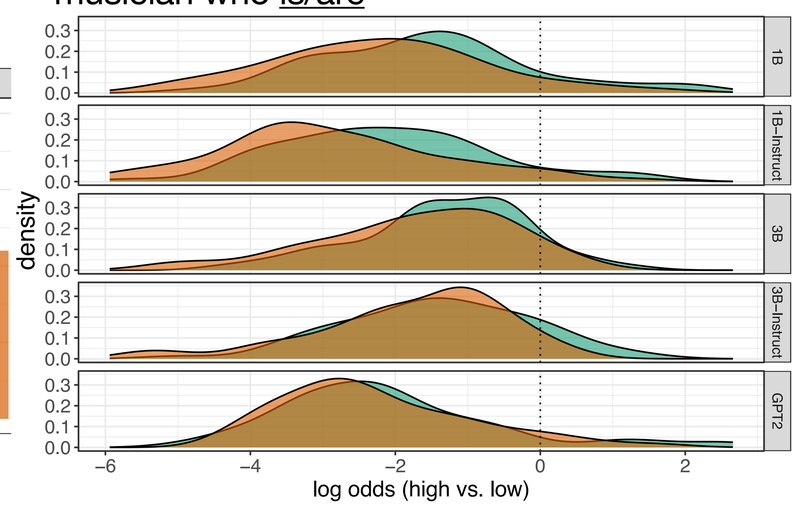
Closed-source models

Prompt
Sentence: Melissa detests the children of the musician who ___.
Options: 1) is, 2) are



Open-source models

Prompt
Sentence: Melissa detests the children of the musician who is/are



Among closed-source models, only GPT-4 shows a higher high-attachment preference for IC verbs than for nonIC verbs, where the other two models do not show a significant difference between the two verb types.
All Llama models have a higher bias toward the high attachment cite for IC verbs than for nonIC verbs, suggesting that not only can the models infer elicitures, but also anticipate them as a source of information when performing word prediction. GPT-2 does not show the predicted behavior, as it appears to lack the ability to draw elicitures in the first place.

Discussion

LLMs have the ability to make non-mandated pragmatic enrichments in the form of conversational elicitures, with larger and more recent models demonstrating sensitivity to the influence of pragmatic inferences on syntactic processing.
Many factors (e.g., model size) could contribute to the improved performance observed in Llama models than compared to the GPT-2 model. Moreover, although both GPT-3.5-turbo and GPT-4 displayed the ability to detect elicitures in Exp. 1, both models failed to show the expected increase in high-attachment bias in the IC verb condition in Exp. 2. Future work should evaluate a wider range of models from different model families that vary in model size and training objective.